SOLID WASTE STREAM ANALYSIS TRAINING MANUAL

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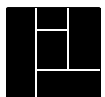
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INTRODUCTION

Effective management of municipal solid waste (MSW) and the choice of a local strategy for integrated management requires that a city identify all major factors influencing the region, i.e., to specify its geopolitical boundaries.

One such factor, and perhaps the most fundamental one regarding the future management of MSW, is the MSW stream: its quantity and morphological composition. What type and how much is generated as waste today? How much will be generated in the future? What is the nature of municipal waste? If decision makers can answer these questions they will be able to set objectives and tasks to address local problems in the area of waste management.

Waste stream quantity and composition is of significant importance for modern MSW management. New trends in solid waste management have made planners and managers turn to the best technologies and alternative solutions, even for individual segments of the waste stream.

RESIDENTIAL SOLID WASTE MANAGEMENT IN BULGARIA

Waste management in Bulgaria is not regulated by any law.[2] This is the main reason for the inefficient state policy regarding waste reduction, reclamation, treatment and disposal.

The Ministry of Environment has developed a draft Waste Act. It was discussed and approved by the Council of Ministers and submitted to Parliament. The Waste Draft Act establishes the competent bodies and their regulatory and supervisory authorities with regard to MSW generation and treatment activities. The competent bodies as described in the draft act are:

— Municipal Administrations (MA)
— Regional Environmental Protection Inspectorates (REPI)
— Hygienic Epidemiological Inspectorates (HEI)
— Ministry of Environment (MOE)

However the legislation remains an act, and the legislative approval procedure is not time limited. The lack of a legal framework prevents the

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[1] This manual has been developed to serve the primary clients of the LGI—Bulgarian municipalities and local government officials. It was originally prepared in Bulgarian and translated into English using a translator with significant expertise in similar technical translations. It may contain technical language that is inconsistent with US terms and definitions.

[2] As of May 1997.

implementation of any economic or administrative measures for waste minimization or reduction. Current activities include feasibility studies for such measures, persuasion and education.

Despite the lack of appropriate legislation, the Council of Ministers did enact a decree No. 153 on the collection, transportation, treatment and disposal of hazardous wastes on August 6, 1993.

Legislative Review

No legal act discusses the management of activities connected with the generation, storage, collection, transportation, treatment and disposal of solid waste. Article 20 of the Local Government and Local Administration Act (SG No. 77 of 1991) defines the Municipal Council as the lead body in determining local government policies, including public utilities management and environmental protection policies. The responsibilities involved, and the supervision of this regional policy, however, are not explicitly stated in Bulgarian legislation.

Territorial, Urban and Rural Development Act. Public works in settlements and other community services are treated by the Territorial, Urban and Rural Development Act (TURDA). This Act, however, does not mention MSW as an element of community services. In the Rules for Implementation of the Territorial Urban and Rural Development Act (SG No. 62 of 1973), solid waste is treated as "an element of protecting the urban environment and making it more healthy for habitation."

Article 200 states: "Solid waste cleaning activity in human settlements aims at creating and maintaining a high standard of sanitary culture. This activity includes collection, removal, treatment, reclamation and disposal of solid waste.

Article 201 specifies:

! Collection and removal of solid waste is to be done with modern technical equipment, in compliance with sanitary requirements, and ensuring that citizens are not disturbed.

! Distances between solid waste treatment sites and populated areas are set in compliance with the adopted technology while abiding with the established zoning requirements for sanitary protection.

! (Amended - SG No. 48 of 1985) These sites are constructed, located and operated on the basis of project plans approved by the Chairman of the District People Council's Executive Committee, or an official appointed by him. Projects should include measures for:

    — Protection of ground and underground natural resources; and

    — Land reclamation of the respective sites and their incorporation into the surrounding environment.

    ! Industrial solid waste treatment is accomplished on the basis of approved projects. The projects also include measures for the reuse of solid waste.

<u>Decree No 153</u>

Issues relating to hazardous waste treatment are regulated comprehensively in Decree No 153 of the Council of Ministers.

Article 8 states: "Hazardous waste treatment is accomplished by individuals and legal entities possessing permits therefor."

Article 9 The costs for waste collection, transportation, and treatment are at the expense of the parties which generate the said waste.

Articles 10, 11, 12, 13, 14 require waste generators to declare waste composition and quantity, storage and collection details, and these activities are obligatory for all generators of hazardous waste.

Articles 21 - 27 deal with waste processing and treatment.

Articles 33 - 38 regulate the controls over hazardous waste treatment activities.

The Ministry of Environment forbids or suspends activities connected with treatment of hazardous waste resulting in environmental damage or pollution.

It is necessary, however, to learn from other countries' experience and to develop specific standards for certain hazardous waste such as worked oils, sludge from water treatment plants, organic solvents, car batteries, mercury lamps, and such which are listed in the hazardous waste catalogues in the attachment to the Decree.

For waste in particular, the Environmental Protection Act of 1991 sets out only the obligations connected with environmental impact assessments, issuing of waste treatment instructions, the responsibilities of municipal authorities, and regulates issues of restrictive import and transit transportation regime of waste and hazardous substances.

WASTE STREAM CONSIDERATIONS

General Considerations

Each municipality is different, in the sense that it has its own local conditions that need to be considered carefully in making decisions for the future.

Why is it necessary to examine the waste stream formed in the municipality, to study its quantity (in cubic meters or tons), as well as its morphological composition?

Because it:

— Determines the capacity for future facilities;
— Provides an opportunity to determine the residual storage volume for waste disposal in existing open dump areas or sanitary landfills;
— Determines the materials that could be recycled, reused and reclaimed;
— Determines the required number of containers for waste collection and temporary waste storage, and the capacity of waste transportation vehicles; and
— Provides information to the potential buyers of waste regarding the quantity and type of recyclable materials in the waste.

Municipal solid waste is measured most often by weight, but can be measured by volume too. Waste volume measurement is an important factor in designing sanitary landfills and composting facilities or for planning the capacity and number of transportation vehicles needed.

All future projects for waste management, reduction of their quantities, or estimation of recyclable materials are based on measuring waste by weight (in tons, kilograms).

Seasonal specifics affect MSW quantity and composition. One and the same waste volume will weigh more during the winter or rainy months than in the summer.

Determination of MSW stream characteristics takes a lot of time, if it is to be as close to the actual condition as possible. But the more the collected data and details, the better the information base for effective waste management. In order to select the best alternative, it is necessary first to identify the **type and quantity of the individual waste components.**

The data collected at the local (municipal) level can differ significantly from the national average statistics.

To characterize a waste stream, it is necessary to undertake the following steps.[3]

— Evaluate the existing MSW quantities and determine the generation source;
— Waste stream composition analysis;
— Estimate the future MSW quantities based on forecasts;
— Forecast the morphological composition of expected MSW;
— Identify the existing special waste in the region; and
— Establish the existing waste traffic (import and export) for the particular region.

It is important to account for the fact that waste sometimes differs by individual regions of a settlement. This specially refers to the comparison between urban and rural regions.

All literature sources explicitly stress that the development of a plan for a waste stream study and analysis can be successfully performed by a person with technical knowledge in the area of solid waste management, i.e. by a qualified and experienced solid waste management professional, or in a close collaboration with such professionals [2, 4, 7, 8].

Waste Stream Study Plan

A plan for taking waste samples needs to be developed before undertaking solid waste quantitative measurement and composition analysis. This plan depends on the following characteristics:

— Population size;
— Demographics of the region examined;
— Standard of living;
— Waste transportation method, type of transportation vehicles and type of waste collection containers;
— Places of waste generation (differentiation of the regions of the municipality studied, depending on the level of built up area in different regions);
— Time of sample taking (seasonal features); and
— Heating system used in the locality.

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[3] Source: Regional Development Center of Coastal Georgia.

Sources of Waste.
To obtain precise data in the course of the examination, it is necessary for the waste stream to be examined separately for the following different waste sources:

— Prevailing structure of the rural type;
— Prevailing suburban structure;
— Urban type structure (low-rise buildings);
— High-rise apartment blocks;
— Commercial areas; and
— Marketplaces.

Timing.
MSW seasonal variations are significant, especially with a view of the organic and mineral ingredients. In regions with a great number of local heating systems based on coal and other solid fuels, the contents of ash, paper, cardboard and plastics vary significantly during the different seasons. Ash quantities are particularly large in the fall and winter.

To determine the annual stream structure and the trends in the total stream quantity and composition, it is necessary to develop a program for analyses for the different seasons.

In most general terms, it is assumed that solid waste generation and composition can be defined precisely by performing **at least three analyses over the calendar year**. If the data for the studied region are not exhaustive or data collection has started recently, it is recommended to make four seasonal analyses annually.

Generally, the analyses program should last one week - this is the standard case and usually provides a sufficient number of samples.

If there are no resources available for sample taking in the course of one week, it is enough to start with sample taking once a week, several times per month, in order to gather sufficient data for waste composition projection.

Continuous sample taking and sorting of waste provides the necessary data and serves as a sufficient basis for serious planning of the next stages for the MSW Management Plan for the municipality.

The exact number of samples which can be sorted per day varies and depends on the municipal specialist's level of experience and the number of assisting staff.

It is recommended that periodic (at least once every 5 years) waste samples be taken. This will provide an opportunity for the verification of the original composition study as well as accurate reflection of the changes over time.

Stratification of Total Waste Quantity.

 # Stratification of Total Waste Quantity. To obtain the most exhaustive information for the waste collected in a given region, and more precisely for the collected data presented as equal investment of time and labor, a statistical subdivision according to a variety of criteria is carried out for the total waste quantity. From a statistical view point this means obtaining information for known values affecting variable values, which can be used to arrive at important conclusions concerning projected solid waste generation and composition.

 # Considerations Related to the Type of Waste Containers and Type of Transportation System. The results of various waste stream analyses and studies [4, 2, 7] show that waste quantity and volume, as well as waste composition, are proportional to the waste container size. Waste from larger volume containers are normally in free volume packaging, while people using small waste containers are forced to reduce waste quantity. The latter is accomplished through waste compaction using collection systems which are designed for recycling of materials.

Before carrying out a waste stream analysis, it is necessary to carefully study the systems for collection, storage, routes and timing of waste collection for a given region or municipality and to make the necessary conclusions for further examination.

As mentioned above, a higher accuracy can be accomplished **through an appropriate stratification by permanent investment of time and labor.** Local and regional managers should take this into consideration.

SOLID WASTE STREAM ANALYSIS (Practical Implementation)

The most precise method for analyzing waste quantity and composition includes examining the samples, manual sorting and weighing, as well as processing results and performing a composition analysis.

Taking a Sample

Municipal solid waste composition from the municipalities is heterogeneous and highly variable. Its precise and thorough examination is extremely difficult. It is necessary to determine the average content of large quantities of heterogeneous waste.

In order to obtain precise data during the study, it is necessary to examine the waste in a differentiated manner taking into account the place of origin:

— Rural regions;

— Residential regions; and
— Commercial regions.

After identifying the typical regions for sample taking, it is necessary to specify the type of transport vehicle or container, level of filling, and other data (see Appendix 2).

Manual Sorting

The waste is dumped from the transport vehicle onto a leveled platform. The dumped waste is thoroughly mixed and leveled in thin layers (25-30 centimeters) on a hard smooth surface in the shape of a circle. The circle is divided into four, and the waste from the two opposite segments is discarded. The remaining two parts are joined and mixed again, and then spread again in the shape of a circle and leveled out. This procedure is repeated until an average sample of about 25-40 kilograms is left depending on the waste quantity. The initial weight of the average sample is then recorded.

The sack of waste is emptied onto a plastic folio sheet and the waste is separated by manual sorting in the following groups: plastics; paper; metals; domestic (food, garden and other organic wastes); leather, rubber and textile; ceramics, construction waste, rocks, ash.

Every single waste group is stored in an individual paper sack and weighed. The individual waste components are calculated as a percentage of the total weight and noted in the respective tables.[4]

Manual sorting allows the establishment of the precise material composition of each individual sample series. The data series gathered in this manner can be subjected to statistical analysis.

Waste Quantitative Study (Measurement)

To establish the total flow of solid waste, it is necessary to weigh the entire contents of waste collection trucks arriving from every region selected for the period of at least one week. A longer period of 3-4 weeks is recommended. This allows the collection of more reliable data. The complete waste stream quantitative analysis requires three analyses within one year to determine the waste quantity from a given region, municipality or district.

If there is no weighing bridge at the location of waste treatment or disposal, the respective municipal unit or the private transportation company

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[4]   See Appendix 1.

needs to ensure that they are measured at another place, before waste treatment and disposal.

Before starting waste quantitative measurement, it is necessary to gather preliminary information on:

> ! Type of transportation vehicles used for waste collection in the respective region or municipality—i.e., their technical operation properties describing general design characteristics with regard to operation. Such indicators include: mass utilization coefficient, relative load capacity, relative carriage/container volume per ton of load capacity, relative engine power, compaction ratio.

> ! Total daily number of trips to the landfill of every type of waste collecting vehicle.

> ! Waste quantity transported daily by every single transportation vehicle. When total daily waste quantity is less than 100 tons/day, this information is even more useful when recorded for every truck.

Quantitative measurement data should be recorded in tables for easier calculation.[5]

EVALUATIONS, PROJECTIONS AND REPORTS

The results from the analyses and studies described above should be calculated for the number of citizens in the examined region or municipality: kilograms per capita per day, kilograms per capita per year[6]; annual waste quantity, volume weight, average values of expected annual quantities on the basis of the morphological composition.

Other results can be subjected to further statistical analysis.

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[5]   See Appendices 2 and 3.

[6]   See Appendix 3.

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APPENDIX 1
INDIVIDUAL WASTE COMPONENTS

Collection	Total Sample Weight	Glass		Plastics		Paper		Metals		Domestic, Garden etc.		Leather, rubber, textile		Ceramics, construction, etc.	
		kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%
1															
2															
3															

APPENDIX 2
WASTE QUANTITATIVE STUDY

Date of measurement	Waste collection region	Type of transport vehicle	Waste and truck height	Waste net weight	Weight by volume tons m^3
1	2	3	4	5	6

APPENDIX 3
EVALUATIONS, PROJECTIONS, AND REPORTS

Region Studied	Annual quantity of MSW tons/year	Weight by volume tons/m^3	kg/capita/year	kg/capita/year